CERTIFICATION OF TRANSLATION

I, ***Eun-mee Won***, an employee of Y.P. LEE, MOCK & PARTNERS of Koryo Bldg., 1575-1 Seocho-dong, Seocho-gu, Seoul, Republic of Korea, hereby declare under penalty of perjury that I understand the Korean language and the English language; that I am fully capable of translating from Korean to English and vice versa; and that, to the best of my knowledge and belief, the statement in the English language in the attached translation of ***Korean Patent Application No. 10-2003-0015858*** consisting of pages, have the same meanings as the statements in the Korean language in the original document, a copy of which I have examined.

Signed this 6th day of July 2007

Eunmee Won

ABSTRACT

[Abstract of the Disclosure]

There are provided a disc on which management of a spare area can be performed for defect management, and a method of managing the spare area. The disc, which includes a lead-in area, a data area, and a lead-out area, further includes a temporary disc defect structure (TDDS) area formed on at least one of the lead-in area, the data area, and the lead-out area. The TDDS area stores information regarding a spare area for temporary defect management. Accordingly, when allocating a spare area to the data area for defect management, a disc driver determines whether the spare area is allocated, and allows defect management and data recording according to the determining result. Also, it is possible to allow the disc driver to immediately access a desired region by recording bitmap information indicating a data recording region.

[Representative Drawing]

FIG. 3

SPECIFICATION

[Title of the Invention]

DISC CAPABLE OF MANAGING SPARE AREA FOR DEFECT MANAGEMENT, AND THE METHOD THEREOF

[Brief Description of the Drawings]

FIG. 1 illustrates structures of a write once disc according to an embodiment of the present invention.

FIG. 2 illustrates a structure of a single record layer disc allowing management of a spare area for defect management, according to an embodiment of the present invention.

FIG. 3 illustrates a detailed structure of a temporary disc defect structure (TDDS) area shown in FIG. 2.

FIG. 4 illustrates a detailed structure of a space bit map (SBM) area of FIG. 2.

FIG. 5 illustrates a structure of a single record layer disc allowing management of a spare area for defect management, according to another embodiment of the present invention.

FIG. 6 illustrates a detailed structure of a TDDS + SBM area shown in FIG. 5.

FIG. 7 illustrates a structure of a single record layer disc allowing management of a spare area for defect management, according to yet another embodiment of the present invention.

FIG. 8 illustrates a detailed structure of a temporary disc management area (TDMA) shown in FIG. 7.

FIG. 9 illustrates a detailed structure of a disc & drive information + SBM area shown in FIG. 7.

FIG. 10 illustrates a structure of an SBM area according to an embodiment of the present invention.

FIG. 11 illustrates a finalized SBM area according to a preferred embodiment of

the present invention.

FIG. 12 is a flowchart illustrating a method of managing a spare area of a disc for defect management, according to an embodiment of the present invention.

[Detailed Description of the Invention]

[Object of the Invention]

[Technical Field of the Invention and Related Art Prior to the Invention]

The present invention relates to a disc on which a spare area can be managed for defect management, and a method of managing the spare area.

Defect management is performed to allow a user to rewrite user data of a portion of a user data area in which a defect occurs to a new portion of the user data area of a disc, thereby compensating for a loss in data caused by the defect. In general, defect management is performed using linear replacement or slipping replacement methods. In the linear replacement method, a user data area in which a defect occurs is replaced with a spare data area having no defects. In the slipping replacement method, a user data area having a defect is slipped to use the next user data area having no defects.

Both linear replacement and slipping replacement methods are applicable only to discs such as a DVD-RAM/RW on which data can be repeatedly recorded and recording can be performed using a random access method.

Meanwhile, methods of disc defect management even on a write once disc on which rewriting of data is not allowed, using the linear replacement method have been developed.

However, there are cases where disc defect management cannot be performed on a write once disc with a disc driver, using the linear replacement method. For instance, when data is recorded on the write once disc in real time, it is difficult to perform disc defect management thereon with the disc driver, using the linear replacement method.

For this reason, a spare area is preferably allocated to a write once disc only when disc defect management using the recording/reproducing apparatus is required.

That is, the allocation of the spare area is preferably determined by a user's intention.

When the user determines to allocate a part of a data area as a spare area for defect management, information regarding the spare area is preferably recorded on the disc so that the disc driver can recognize the location or the size of the spare area.

After a write operation, information that specifies all areas containing data is written in a bit map format to a predetermined area of a disc, thereby enabling facilitation of a further write operation or a read operation. In other words, a plurality of clusters on which data recording is possible are divided into clusters that store data and blank clusters, and the information of the clusters are recorded in a bit map format, thereby allowing a recording or reproducing apparatus to readily access a desired area.

In particular, bit map information specifying areas containing data is very useful when using a write once disc. In other words, it is required to fast detect a cluster next to a cluster in which data is most recently recorded so as to write data to the write once disc. The bit map information enables fast detection of the next cluster.

Also, it is possible to check a change in the recording state of a write once disc and detect the original data recorded before the change occurs, using the bit map information. The disc recording state may change by recording further data to the write once disc containing data.

[Technical Goal of the Invention]

The present invention provides a disc on which a disc driver can recognize whether a spare area is allocated thereto when the spare area is allocated for defect management, and a method of managing the spare area.

[Structure of the Invention]

According to an aspect of the present invention, there is provided a write once disc in which a lead-in area, a data area, and a lead-out area are sequentially formed, the disc comprising a temporary disc defect structure (TDDS) area formed on at least one of the lead-in area, the data area, and the lead-out area. The TDDS area stores

information regarding a spare area for temporary defect management.

The information regarding the spare area may specify the size of the spare area.

The write once disc may further include a space bit map (SBM) information area for recording information regarding a data recording area, and the information regarding the data recording area may include a bit map indicating head information and a region containing data.

When the information regarding the spare area is recorded in a predetermined cluster of the TDDS area, bits of the bit map corresponding to the predetermined cluster are recorded with a predetermined value indicating that the cluster contains the information. The head information preferably includes a finalization flag that indicates whether additional data may be recorded on the disc.

According to another aspect of the present invention, there is provided a method of managing a spare area for temporary defect management, the method including (a) allocating a spare area to a predetermined area of a write once disc for temporary defect management, and (b) recording information regarding whether the spare area is allocated on a predetermined area of the write once disc.

Information regarding the spare area preferably specifies the size of the spare area.

The method preferably further includes (c) recording information regarding a data recording area.

The information regarding the data recording area preferably includes head information and a bit map that indicates an area containing data.

(c) preferably includes (c1) recording a bit value of the bit map, which corresponds to the predetermined area containing the information indicating whether the spare area is allocated, with a predetermined value indicating the data recording area. The head information preferably includes a finalization flag indicating whether additional data may be recorded on the write once disc.

Hereinafter, exemplary embodiments of the present invention will be described in detail with reference the accompanying drawings.

FIG. 1 illustrates structures of a write once disc (hereinafter referred to as the 'disc') according to an embodiment of the present invention.

(a) of FIG. 1 illustrates a disc that is a single record layer disc having a record layer *L0*. The disc includes a lead-in area, a data area, and a lead-out area. The lead-in area is located in an inner part of the disc and the lead-out area is located in an outer part of the disc. The data area is present between the lead-in area and the lead-out area and is divided into a user data area and a spare area. The spare area has a predetermined size starting from the beginning of the data area.

(b) of FIG. 1 illustrates a disc that is a double record layer disc having two record layers *L0* and *L1*. A lead-in area, a data area, and an outer area are sequentially formed from an inner part of the first record layer *L0* to its outer part. Also, an outer area, a data area, and a lead-out area are sequentially formed from an outer part of the second record layer *L1* to its inner part. Unlike the single record layer disc of FIG. 1(a), the lead-out area of the second record layer *L1* is present in the inner part of the second record layer *L1*. That is, the disc has an opposite track path (OTP) in which data is recorded starting from the lead-in area at the inner part of the first record layer *L0* toward the outer part and continuing from the outer area of the second record layer *L1* to the lead-out area at the inner part. Spare areas are allocated to the first and second record layers *L0* and *L1*, respectively.

In this embodiment, the spare areas are present between the lead-in area and the user data area and between the outer area and the user data area. However, the positions and numbers of spare areas are not limited.

FIG. 2 illustrates a structure of a single record layer disc on which a spare area can be managed for defect management, according to an embodiment of the present invention. Referring to FIG. 2, a lead-in area of the disc includes Defect Management Areas (DMA) *DMA1* and *DMA2*, a recording condition test area, a Temporary Disc Defect Structure (TDDS) area, a Temporary DeFect List (TDFL) area, a space bit map area, and a disc & drive information area.

In general, when a disc is loaded into a disc drive, the disc drive reads

information from a lead-in area and/or a lead-out area so as to determine as to how to manage the disc and perform a read/write operation. Therefore, if the amount of the information recorded in the lead-in area and/or the lead-out area increase, a longer time will be spent preparing the recording or reproducing of the data after loading the disc. To solve this problem, the present invention proposes temporary management information containing a TDDS and a TDFL, the temporary management information being recorded in a TDFL or a TDDS formed, separated from the lead-in area and/or the lead-out area.

If no more data will be recorded on the disc, the recording/reproducing apparatus begins disc finalization during which recorded TDFL and TDDS are recorded as defect management information in the DMA. Through the disc finalization, only most recently recorded TDFL and TDDS are copied to the DMA. Accordingly, the disc drive can complete disc initialization rapidly by reading only the most recently updated information from the DMA. In this case, the defect management information is stored in a plurality of areas, thereby increasing the reliability of information.

Disc defect management according to this embodiment uses the linear replacement method, and thus, the TDFL specifies an area, i.e., a defective area, of the disc in which a defect occurs, and a replacement area that substitutes for the defective area. More preferably, the TDFL further specifies whether the defective area is a single defective cluster, or a continuous defective cluster in which a series of defects occur physically. The TDDS, which is information for managing the TDFL, specifies the recording position of the TDFL.

The lead-in area includes the SBM area that contains bit map information regarding an area containing data, i.e., information regarding a data recordable area.

The data area includes spare areas #1 and #2 and a user data area. In this embodiment, the spare areas #1 and #2 are formed at the start and end of the data area, respectively, for a case where disc defect management is performed using a disc drive during disc initialisation.

The lead-out area includes DMAs #3 and #4 and other areas.

When a user determines disc defect management using the disc drive and instructs the disc drive to allocate spare areas in a data area, the disc drive allocates the spare areas #1 and #2 to predetermined portions of the data area, e.g., at the start and end of the data area.

Then, the disc drive records area allocation information, which indicates the allocation of the spare areas #1 and #2, in a first cluster of a TDDS area. For instance, the information may specify the sizes of the spare areas #1 and #2. When the spare areas #1 and #2 are determined to be respectively located at the start and end of the data area, the disc drive can recognize the allocation of the spare areas #1 and #2 and their positions and sizes only based on information regarding the spare area sizes. In this embodiment, the area allocation information is recorded in the TDDS area but can be recorded in another area.

After recording the information in the first cluster of the TDDS, a bit map is recorded in a first cluster of the SBM area, the bit map recording bit corresponding to the positions of the first clusters of the TDDS and the SBM area with 1 and recording bits corresponding to the positions of the other clusters as 0.

If the user does not desire to perform disc defect management using the disc drive, the disc drive records the area allocation information, which describes the sizes of the spare areas #1 and #2 as 0, in the first cluster of a temporary DMA (TDMA).

Thereafter, a bit map, which indicates the bits corresponding to the positions of the first clusters of the TDDS and the SBM area as 1 and indicates the bit corresponding to the positions of the other clusters as 0, is recorded in the first cluster of the SBM area.

In general, allocation of spare areas for defect management is performed through disc initialisation before initially user data on the disc.

FIG. 3 illustrates a structure of the TDDS area shown in FIG. 2, according to a preferred embodiment of the present invention.

A TDDS is recorded in a cluster of a TDDS area at least once until a recording operation ends. In general, a plurality of TDDS #0, TDDS #1, ... are recorded in the

TDDS area. In this embodiment, TDDS #0 is recorded in a cluster of a TDDS area once when a recording operation ends.

Referring to FIG. 3, the TDDS area consists of a plurality of clusters. A cluster is a basic unit of record and consists of sectors of a predetermined number. A sector is a physical basic unit of a disc.

During disc initialization, when a user determines whether a spare area will be allocated or not, area allocation information indicating the user's determination is recorded in the TDDS #0.

The TDDS #0 includes a TDDS identifier, counter information indicating the number of times the TDDS #0 is updated, the number of a first physical sector of a disc and drive information area, the number of a first physical sector storing a corresponding TDFL if any, and information regarding the sizes of spare areas #1 and #2. As previously described, when the user does not require disc defect management using the disc drive and allocate spare areas in a data area, the sizes of spare areas #1 and #2 are recorded as '0'.

Although a detailed structure of a TDFL area is not illustrated, a TDFL #i contains information regarding defects occurring in data recorded during a recording operation #i and information regarding replacements for the defects. Also, previous TDFLs #0, #1, #2, ..., #i-1 are not accumulated in the TDFL #i and only information regarding defects occurring in a recording area made during the corresponding recording operation #i is recorded in the TDFL #i, thereby minimizing a recording capacity and enabling efficient use of a recording space of a TDDS.

FIG. 4 illustrates a structure of the SBM area shown in FIG. 2, according to a preferred embodiment of the present invention. A SBM area consists of a plurality of clusters and each SBM #i is recorded in a cluster.

Each SBM #i includes an SBM header area and a bit map area. In the SBM header area, SBM identifier information, counter information indicating the number of updating the SBM #i, and a finalization flag are recorded. The finalization flag will be later described.

The bit map area contains a bit map that indicates clusters containing data and blank clusters with different bit values in cluster units with respect to entire recordable areas of a disc.

After recording a TDDS #0, an SBM #0 is recorded in a first cluster of the SBM area. In the bit map of the SBM #0, a bit corresponding to the position of a first cluster of a TDDS and a bit corresponding to the position of the first cluster are expressed with 1, and bits corresponding to the remaining clusters are expressed with 0.

Accordingly, recording size information regarding spare areas in the TDDS #0 allows the disc drive to check the presence of spare areas and determine the positions or sizes of allocated spare areas. Also, the disc drive is capable of rapidly recognizing an area containing data and a blank area of the disc by recording the SBM #0 after recording the TDDS #0.

In the disc, shown in FIG. 2, according to an embodiment, a TDDS area, a TDFL area, and an SBM area are individually formed and a TDDS, a TDFL, and an SBM are recorded therein in cluster units, respectively. However, recording of the TDDS and the SBM is not limited to these areas, that is, they may be recorded in different areas.

FIG. 5 illustrates a structure of a single record layer disc on which a spare area can be managed for defect management, according to another embodiment of the present invention. In this embodiment, a lead-in area includes an area in which both a TDDS and an SBM are recorded.

When a user desires to perform disc defect management using a disc drive and instructs the disc drive to allocate spare areas, the disc drive allocates spare areas #1 and #2 at the start and end of a data area in predetermined sizes, respectively.

Then, the disc drive records allocation information, which indicates the allocation of the spare areas #1 and #2, in first clusters of the TDDS and the SBM.

FIG. 6 illustrates a detailed structure of a TDDS + SBM area shown in FIG. 5. Referring to FIG. 6, a TDDS and an SBM are recorded in a cluster. The TDDS contains size information, i.e., area allocation information, regarding each spare area and the SBM, and the SBM contains a bit map.

After recording information regarding a spare area in a first cluster of the TDDS + SBM area, the bit map records a bit for the position of the first cluster of the TDDS + SBM area as 1 and bits for the positions of the other clusters as 0.

FIG. 7 illustrates a structure of a single record layer disc on which a spare area can be managed for defect management, according to yet another embodiment of the present invention. In this embodiment, a lead-in area includes a Temporary Disc Management Area (TDMA) area in which both a TDFL and a TDDS are recorded, and a disc & drive information + SBM area in which both disc and drive information and an SBM are recorded. That is, the TDFL and TDDS are recorded in a cluster and the disc & drive information and SBM are recorded in a cluster.

Similarly in the above embodiments, a user determines disc defect management using a disc drive and instructs the disc drive to allocate spare areas to a data area of a disc. Then, the disc drive allocates spare areas #1 and #2 to the start and end of the data area in predetermined sizes.

Next, the disc drive records area allocation information that indicates the allocation of the spare areas #1 and #2 in a first cluster of the TDMA.

FIG. 8 illustrates a detailed structure of the TDMA shown in FIG. 7. The TDMA consists of clusters in which disc defect management information is recorded. In each cluster, a TDDS and a TDFL are recorded. The TDDS contains information regarding positions spare areas, the information being area allocation information.

FIG. 9 illustrates a detailed structure of the disc & drive information + SBM area shown in FIG. 7, according to a preferred embodiment of the present invention.

Each cluster contains disc & drive information and SBM information. The SBM information contains a bit map.

Information regarding spare areas is recorded in a first cluster of a TDMA. Next, a bit map indicates bits for first clusters of the TDMA and the disc & drive information and SBM area with 1 and bits for the remaining clusters with 0.

Hereinafter, an SBM that is information regarding a data recording area will be described in greater detail.

FIG. 10 illustrates a structure of an SBM area according to an embodiment of the present invention. Referring to FIG. 10, SBMs #0 through #n which provide data recording area information are recorded in the SBM area. In this embodiment, an SBM #i is recorded in a cluster (i is an integer from 0 to n). However, as illustrated in FIGS. 6 through 9, SBM #i may be recorded together other information in a cluster.

Each SBM #i provides head information containing an SBM descriptor, a finalization flag, and an update counter; and a bit map #i (i is an integer from 0 to n) that indicates recordable areas of entire recording areas of the disc in cluster units.

If data is further recorded on the disc and data recording area information changes, each SBM #i, which contains a new bit map describing data recording areas, is generated and recorded. In this case, the update counter represents the number of updating the data recording area information.

An instant of time when each SBM #i is generated and updated may be differently determined depending on a program installed in a recording apparatus. However, after recording data on the disc, a new SBM #i must be generated and recorded before ejecting the disc from the recording apparatus.

The finalization flag indicates whether the disc is finalized or not.

FIG. 11 illustrates a finalized SBM area according to a preferred embodiment of the present invention. The finalization flag for a head of an SBM is set to 0 and recorded together with other information. Referring to FIG. 16, an SBM recorded right before disc finalization is an SBM #n. If a finalization command is given from a host such as a computer to a disc drive, the disc drive indicates completion of disc finalization by changing a finalization flag among information regarding the SBM #n, which is last updated, from 0 to 1, and recording the SBM #n again.

If necessary, the recording/reproducing apparatus may allow no more SBMs to be recorded by recording data such as "ffh" in an area next to an area containing the SBM #n having the finalization flag '1', thereby preventing additional recording of data on the disc.

A user can maintain the recording state of the disc at an instant of time when disc

finalization is performed, based on an SBM having the finalization flag '1'. Even if data recorded on the finalized disc is changed or new data is added to the original data without permission, it is possible to detect the original data recorded during the disc finalization by referring to a bit map contained in the SBM having the finalization flag '1'. Therefore, data that is added after the disc finalization can be easily detected.

It is preferable that an area in which each SBM #i is recorded is positioned in at least one of a data area, a lead-in area, and a lead-out area as shown in FIG. 1.

In the present embodiment, a TDDS area and an SBM area are allocated to a lead-in area in the above embodiments but may be formed in a data area or a lead-out area.

Although now shown in drawings, a TDFL area may be formed in the data area. In this case, if a user desires disc defect management using a disc drive, the user allocates a spare area #1, a spare area #2, and the TDFL area and records a TDDS and an SBM as described above. The TDFL may be positioned between the lead-in area and the spare area #1, between the spare area #1 and a user data area, at the middle of the user data area, between the user data area and the spare area #2, and between the spare area #2 and a lead-out area,

If the user does not desire disc defect management using the disc drive, the allocation of spare areas is not required. However, if the user records data in real time using disc defect information obtained by scanning a disc, the TDFL area is required to store the disc defect information. Therefore, the TDFL is allocated during disc initialization.

In the above embodiments according to the present invention, management of spare areas and recording of a bit map are described with respect to a single record layer disc. However, the present invention can be applied to a dual record layer disc.

Meanwhile, when a disc according to the present invention is a disc, the disc includes a TDMA for disc defect management. However, if the disc is a re-writable disc, the disc includes a DMA but does not include a TDMA. Therefore, a re-writable disc recording/reproducing apparatus is not capable of reproducing/recording data from/on a

disc with a TDMA, that is, a disc compatibility issue is caused. For a solution to the disc compatibility, a TDFL recorded in a TDDS area is copied to a TDMA prior to finalization of the disc.

FIG. 12 is a flowchart illustrating a method of managing a spare area on a disc for defect management, according to an embodiment of the present invention. Referring to FIG. 12, before recording user data on a write once disc at a first time, a disc drive allocates a spare area to a predetermined area of the write once disc for temporary defect management according to a user's command (operation 110). Predetermined parts of a data area of the disc, e.g., predetermined parts of the start and end of the data area, may be allocated as spare areas.

Next, the drive records information indicating whether the spare areas are allocated on a predetermined point of the disc (operation 130). The information may specify the sizes of the allocated spare areas. When the spare areas are determined to be positioned at the start and end of the data area, the drive can recognize allocation of the spare areas and the locations and sizes thereof by reading the information.

The information may be recorded in a TDDS area formed at least one of a lead-in area, a data area, and a lead-out area. Also, TDDS may be recorded in various regions as illustrated in FIGS. 3, 6, and 8.

After operation 130, data recording area information regarding an area containing area is recorded (operation 150). The data recording area information may be SBM information. The SBM information includes head information and a bit map that indicates an area containing data. It is possible to indicate an area containing new data in the bit map by recording a bit value of the bit map corresponding to the predetermined area, which stores the information indicating whether the spare areas are allocated, as a predetermined value indicating the area containing data.

The head information of the SBM includes a finalization flag indicating whether more data can be recorded on the disc. When the finalization flag is '1', it is possible to check a change in a disc recording state and detect the original data before the change, using a bit map corresponding to the finalization flag 1.

[Effect of the Invention]

As described above, in a disc on which a spare area can be managed for defect management and a method of managing the spare area according to the present invention, when a spare area is allocated to a data area of a write once disc for defect management, information indicating whether the spare area is allocated is recorded on a predetermined area of the disc so that a disc drive can recognize allocation of the spare area. Since bit map information indicating an area containing data is recorded on a predetermined area of the disc, the disc drive can readily access a desired area and it is possible to check a change in a disc recording state when more data is recorded on the disc, for example, and detect the original data before the change

What is claimed is:

1. A write once disc in which a lead-in area, a data area, and a lead-out area are sequentially arranged, the disc comprising a temporary disc defect structure area formed on at least one of the lead-in area, the data area, and the lead-out area,

wherein information regarding a spare area for temporary defect management is recorded in the temporary disc defect structure area.

2. The disc of claim 1, wherein the information regarding the spare area specifies whether the spare area is allocated for temporary defect management.

3. The disc of claim 1, wherein the information regarding the spare area specifies the size of the spare area.

4. The disc of claim 2, wherein the data area comprises the spare area for temporary defect management, and

the information regarding the spare area indicates that the spare area is allocated.

5. The disc of claim 1, further comprising a space bit map information area in which data recording area information is recorded,

wherein the data recording area information contains head information and a bitmap that indicates areas containing data.

6. The disc of claim 5, wherein when the area allocation information is recorded in a predetermined cluster of the predetermined area, a bit of the bit map corresponding to the predetermined cluster is recorded as a predetermined value that indicates the predetermined cluster contains data.

7. The disc of claim 5, wherein the head information comprises a finalization flag that indicates whether more data can be recorded on the disc or not.

8. A method of managing a spare area in a write once disc for defect management, comprising:

(a) allocating a spare area to a predetermined area of the write once disc for temporary defect management; and

(b) recording information indicating whether the spare area is allocated in a predetermined area of the write once disc.

9. The method of claim 8, wherein the information regarding the spare area specifies the size of the spare area.

10. The method of claim 8, wherein (b) comprises recording the information indicating whether the spare area is allocated in a temporary disc defect structure area formed at least one of a lead-in area, a data area, and a lead-out area of the write once disc.

11. The method of claim 8, further comprising (c) recording data recording area information,

wherein the data recording area information comprises head information and a bit map which indicates areas containing data.

12. The method of claim 11, wherein (c) comprises (c1) recording a bit value of the bit map corresponding to the predetermined area, which stores the information indicating whether the spare area is allocated, as a predetermined value indicating an area containing data.

13. The method of claim 11, wherein the head information comprises a finalization flag indicating whether more data is to be recorded on the write once disc.

FIG. 1A

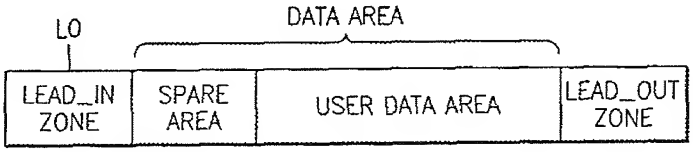

L0
DATA AREA
LEAD_IN ZONE
SPARE AREA
USER DATA AREA
LEAD_OUT ZONE

FIG. 1B

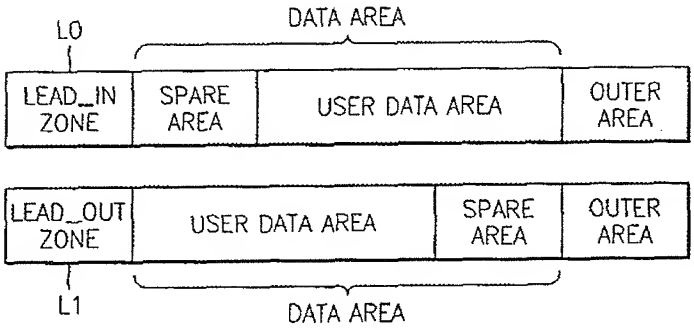

L0
DATA AREA
LEAD_IN ZONE
SPARE AREA
USER DATA AREA
OUTER AREA
LEAD_OUT ZONE
USER DATA AREA
SPARE AREA
OUTER AREA
L1
DATA AREA

FIG. 2

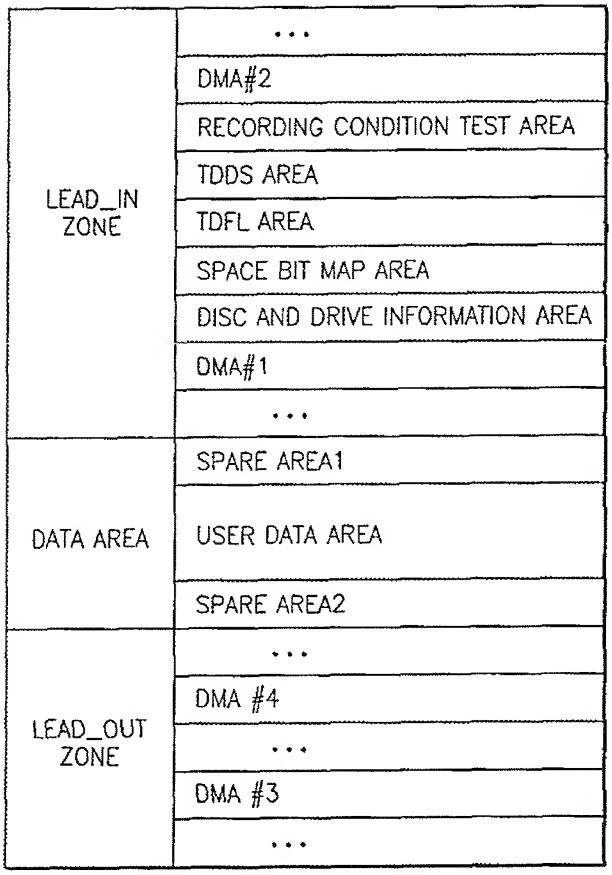

LEAD_IN ZONE
...
DMA#2
RECORDING CONDITION TEST AREA
TDDS AREA
TDFL AREA
SPACE BIT MAP AREA
DISC AND DRIVE INFORMATION AREA
DMA#1
...
DATA AREA
SPARE AREA1
USER DATA AREA
SPARE AREA2
LEAD_OUT ZONE
...
DMA #4
...
DMA #3
...

FIG. 3

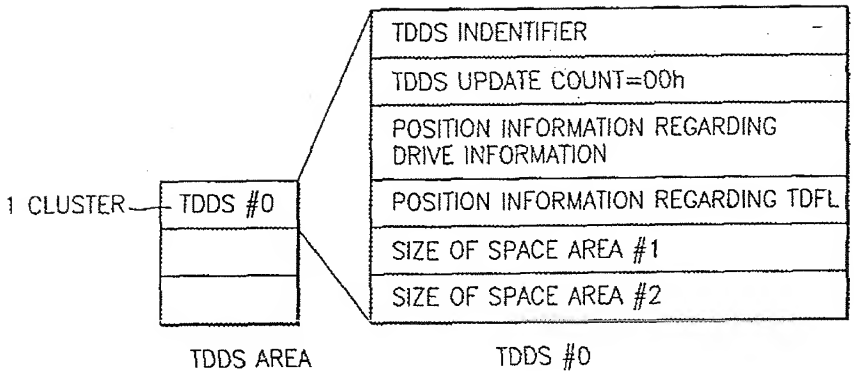

1 CLUSTER
TDDS #0
TDDS AREA
TDDS INDENTIFIER
TDDS UPDATE COUNT=00h
POSITION INFORMATION REGARDING DRIVE INFORMATION
POSITION INFORMATION REGARDING TDFL
SIZE OF SPACE AREA #1
SIZE OF SPACE AREA #2
TDDS #0

FIG. 4

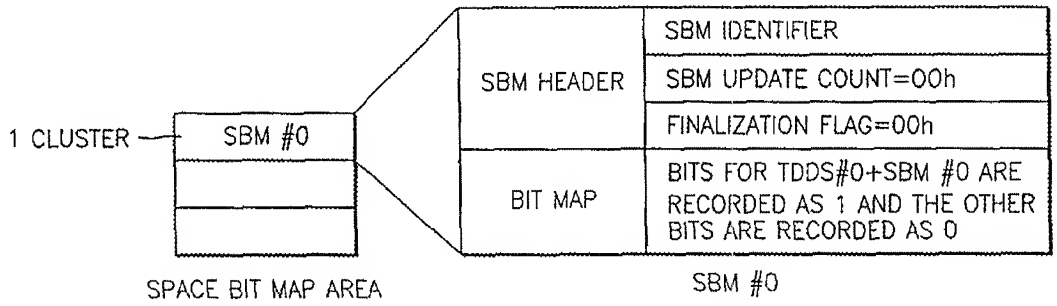

1 CLUSTER
SBM #0
SPACE BIT MAP AREA
SBM HEADER
SBM IDENTIFIER
SBM UPDATE COUNT=00h
FINALIZATION FLAG=00h
BIT MAP
BITS FOR TDDS#0+SBM #0 ARE RECORDED AS 1 AND THE OTHER BITS ARE RECORDED AS 0
SBM #0

FIG. 5

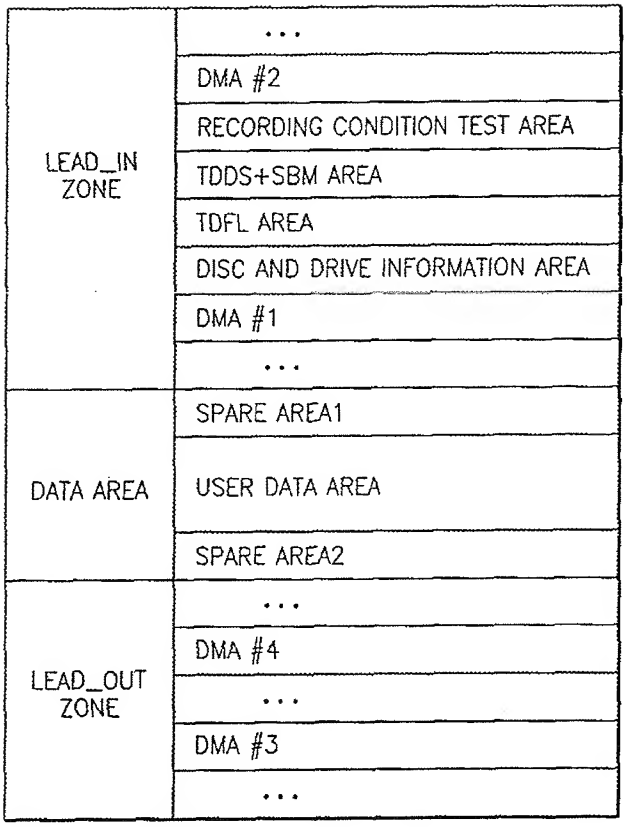

LEAD_IN ZONE
...
DMA #2
RECORDING CONDITION TEST AREA
TDDS+SBM AREA
TDFL AREA
DISC AND DRIVE INFORMATION AREA
DMA #1
...
DATA AREA
SPARE AREA1
USER DATA AREA
SPARE AREA2
LEAD_OUT ZONE
...
DMA #4
...
DMA #3
...

FIG. 6

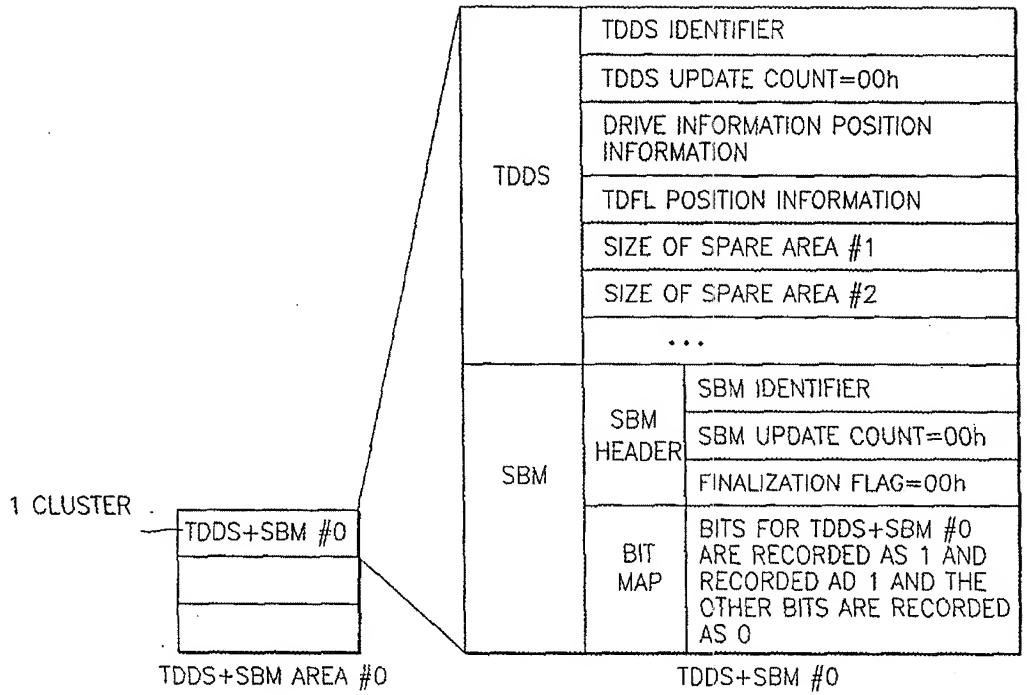

1 CLUSTER
TDDS+SBM #0
TDDS+SBM AREA #0
TDDS
TDDS IDENTIFIER
TDDS UPDATE COUNT=00h
DRIVE INFORMATION POSITION INFORMATION
TDFL POSITION INFORMATION
SIZE OF SPARE AREA #1
SIZE OF SPARE AREA #2
...
SBM
SBM HEADER
SBM IDENTIFIER
SBM UPDATE COUNT=00h
FINALIZATION FLAG=00h
BIT MAP
BITS FOR TDDS+SBM #0 ARE RECORDED AS 1 AND RECORDED AD 1 AND THE OTHER BITS ARE RECORDED AS 0
TDDS+SBM #0

FIG. 7

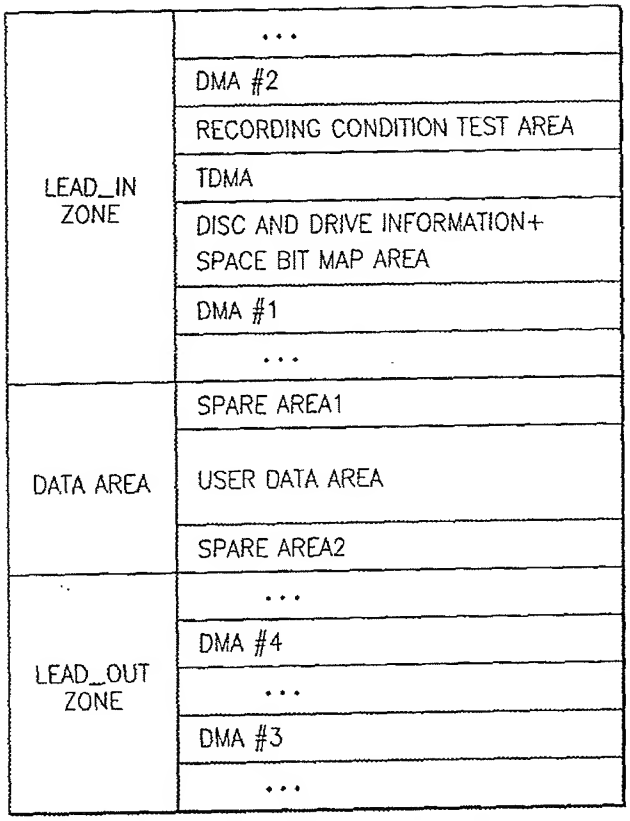

LEAD_IN ZONE
...
DMA #2
RECORDING CONDITION TEST AREA
TDMA
DISC AND DRIVE INFORMATION+ SPACE BIT MAP AREA
DMA #1
...
DATA AREA
SPARE AREA1
USER DATA AREA
SPARE AREA2
LEAD_OUT ZONE
...
DMA #4
...
DMA #3
...

FIG. 8

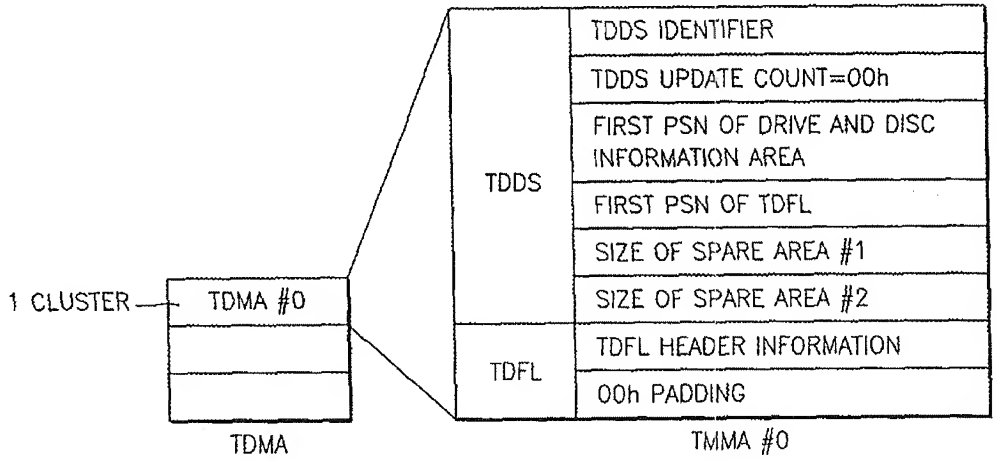

1 CLUSTER
TDMA #0
TDMA
TDDS
TDDS IDENTIFIER
TDDS UPDATE COUNT=00h
FIRST PSN OF DRIVE AND DISC INFORMATION AREA
FIRST PSN OF TDFL
SIZE OF SPARE AREA #1
SIZE OF SPARE AREA #2
TDFL
TDFL HEADER INFORMATION
00h PADDING
TMMA #0

FIG. 9

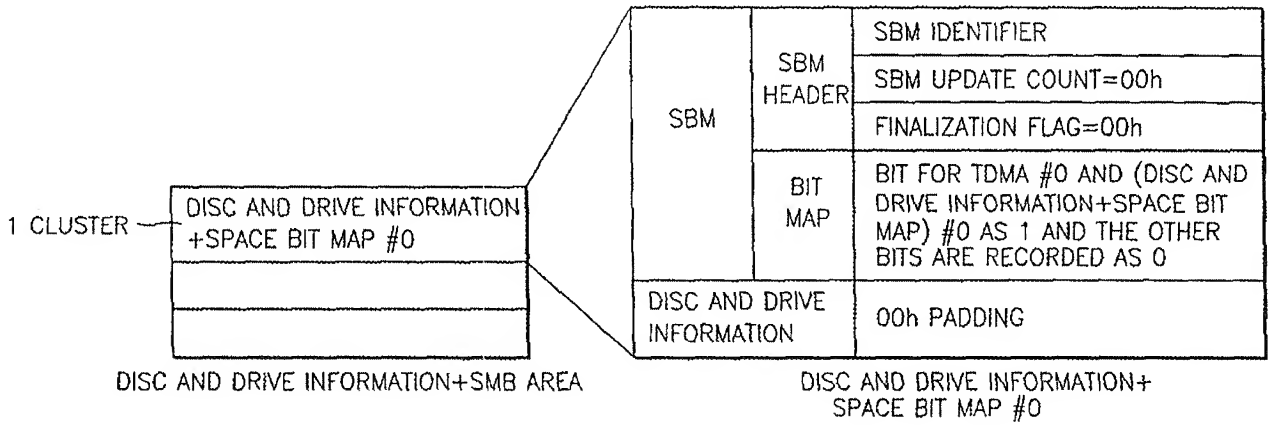

1 CLUSTER
DISC AND DRIVE INFORMATION +SPACE BIT MAP #0
DISC AND DRIVE INFORMATION+SMB AREA
SBM
SBM HEADER
SBM IDENTIFIER
SBM UPDATE COUNT=00h
FINALIZATION FLAG=00h
BIT MAP
BIT FOR TDMA #0 AND (DISC AND DRIVE INFORMATION+SPACE BIT MAP) #0 AS 1 AND THE OTHER BITS ARE RECORDED AS 0
DISC AND DRIVE INFORMATION
00h PADDING
DISC AND DRIVE INFORMATION+ SPACE BIT MAP #0

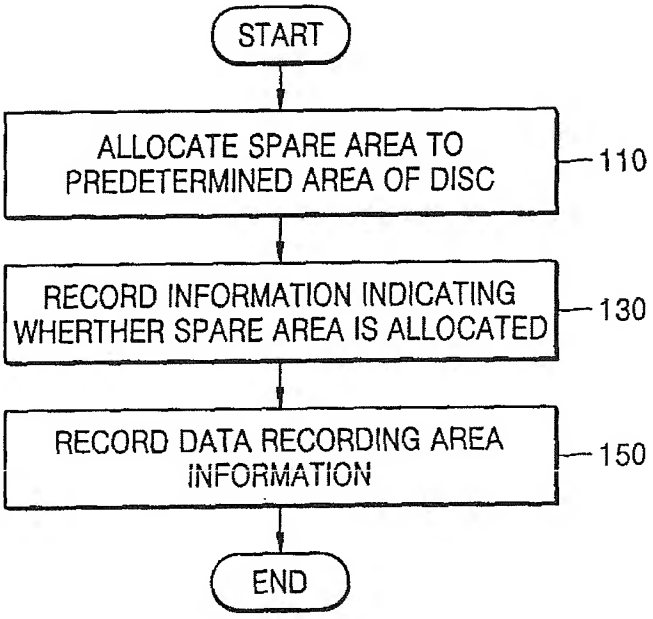
FIG. 10

SBM #0	FINALIZATION FLAG=0
	UPDATE COUNTER=0
	BIT MAP #0
SBM #1	FINALIZATION FLAG=0
	UPDATE COUNTER=1
	BIT MAP #1
...	...
SBM #n	FINALIZATION FLAG=0
	UPDATE COUNTER=n
	BIT MAP #n
...	...

FIG. 11

SBM #0	FINALIZATION FLAG=0
	UPDATE COUNTER=0
	BIT MAP #0
SBM #1	FINALIZATION FLAG=0
	UPDATE COUNTER=1
	BIT MAP #1
...	...
SBM #n	FINALIZATION FLAG=0
	UPDATE COUNTER=n
	BIT MAP #n
SBM #n	FINALIZATION FLAG=1
	UPDATE COUNTER=n
	BIT MAP #n
NON-RECORDING AREA	ffh
...	...

FIG. 12


START
ALLOCATE SPARE AREA TO PREDETERMINED AREA OF DISC
110
RECORD INFORMATION INDICATING WHERTHER SPARE AREA IS ALLOCATED
130
RECORD DATA RECORDING AREA INFORMATION
150
END